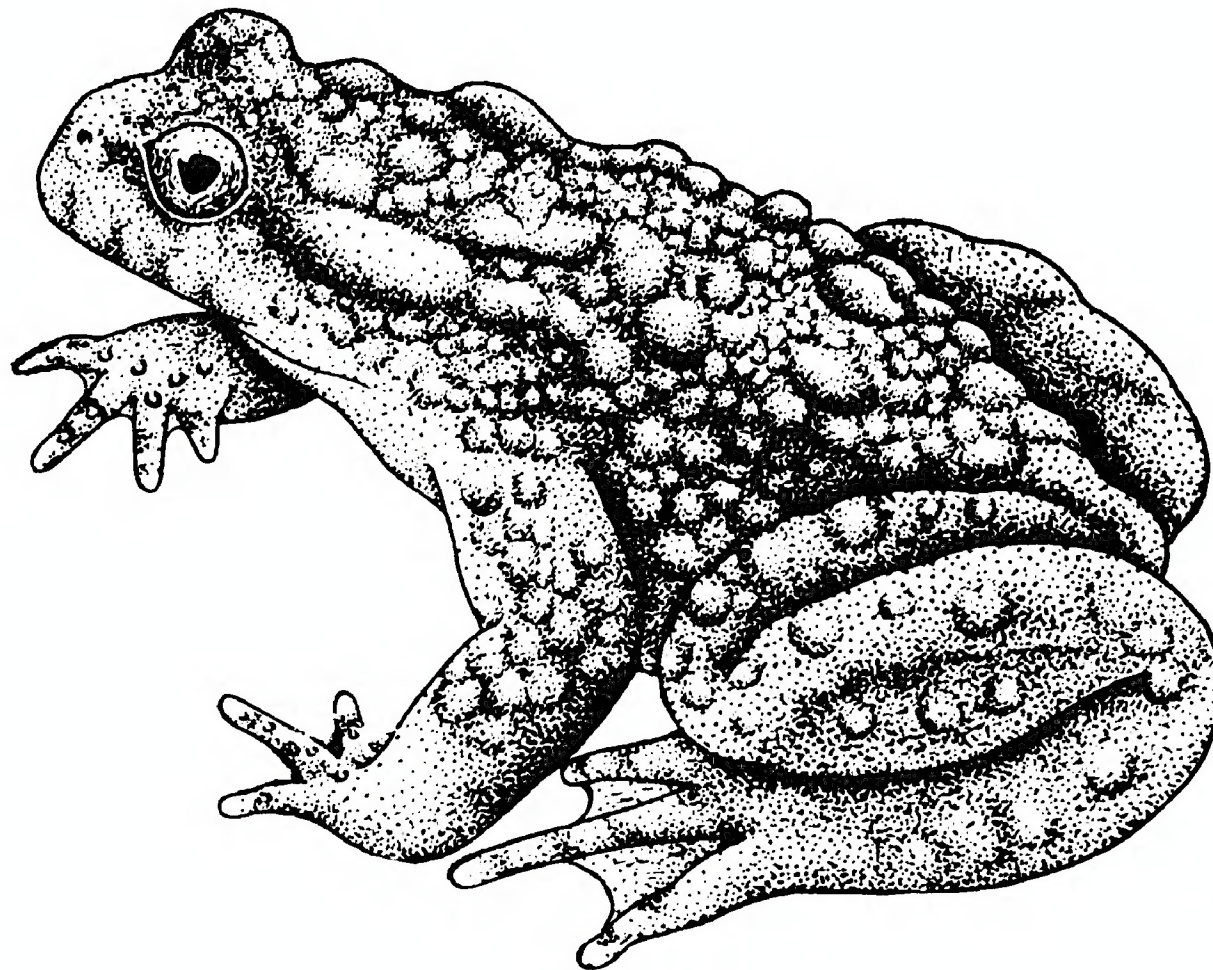

BULLETIN

of the

Chicago Herpetological Society



Volume 47, Number 2
February 2012



BULLETIN OF THE CHICAGO HERPETOLOGICAL SOCIETY

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The Bulletin of the Chicago Herpetological Society (ISSN 0009-3564) is published monthly by the Chicago Herpetological Society, 2430 N. Cannon Drive, Chicago IL 60614. Periodicals postage paid at Chicago IL. **Postmaster:** Send address changes to: Chicago Herpetological Society, Membership Secretary, 2430 N. Cannon Drive, Chicago IL 60614.

On the Cobra Cults of Myanmar (Burma)

Steven G. Platt¹, Win Ko Ko¹ and Thomas R. Rainwater^{2,3}

Snakes are venerated in traditional societies throughout the world for a variety of reasons (Klauber, 1956; Blassingame, 1972; Morris and Morris, 1965; Minton and Minton, 1980; Seal, 2000), and cobras (*Ophiophagus hannah* and *Naja* spp.) figure prominently in the mythology and folk traditions of India, Pakistan, and parts of Southeast Asia (Minton and Minton, 1980; Seal, 2000). In Hindu mythology cobras are revered as direct descendants of the Nagas, ancient serpent gods endowed with the power to cause environmental mayhem, and bring suffering or instant death to people. Earthquakes, tidal waves, volcanic eruptions, droughts, and other natural disasters are attributed to the displeasure of the Nagas, which villagers often seek to appease during times of famine or plague. Altars to Shiva are guarded by stone Nagas and living cobras are encouraged to dwell in Hindu temples. Families often set aside patches of unkempt vegetation in household gardens where it is hoped cobras will take up residence, and small “poison shrines” are maintained for cobra worship (Minton and Minton, 1980; Figure 1). According to Buddhist teachings, cobras played an important role in the life of Gautama Siddhartha, the Indian prince who

later became the Buddha; Nagas assisted in his birth, and formed a bridge with their outspread hoods that allowed him to safely cross the Ganges River. The Buddha also sheltered beneath the hood of a giant cobra while meditating in the desert (Minton and Minton, 1980). Together these Hindu and Buddhist beliefs formed the basis of cobra cults that were once widespread in India and Southeast Asia. Cobra cults have for the most part disappeared, although snake worshiping clans are said to persist in tribal regions of Pakistan and parts of India (Minton and Minton, 1980).

Based on several accounts of travel prior to World War II, similar cobra cults — although observed by few westerners — also existed in Myanmar (at the time known as Burma). Outram (1946) described a ceremony involving hamadryads (i.e., king cobras, *Ophiophagus hannah*) near Mount Popa (20°55'N; 95°15'E; Figure 2), an extinct volcano in central Myanmar (Chhibber, 1934). Because it is thought to be the dwelling place of several important supernatural beings known as Nats (= Earth Spirits), Mount Popa is considered one of the most sacred sites in Burmese Buddhism (Tin Naing Toe, 2004). Originally part of a pre-Buddhist belief system, Nats were later incorporated into Burmese Buddhism and form the basis of elaborate local cults throughout Myanmar (Spiro, 1967). Nats are believed to dwell in forests, hills, fields, water bodies, and even large trees, and are perceived as jealous overlords of their domain, harming those who fail to recognize their suzerainty, while at the same time protecting and rewarding those who acknowledge their dominance by proper propitiation (Spiro, 1967). According to Outram (1946), Nats inhabiting Mount Popa were believed to have charged hamadryads with guarding their shrines on the mountain.

Outram (1946) accompanied residents of Chaingwa (a small

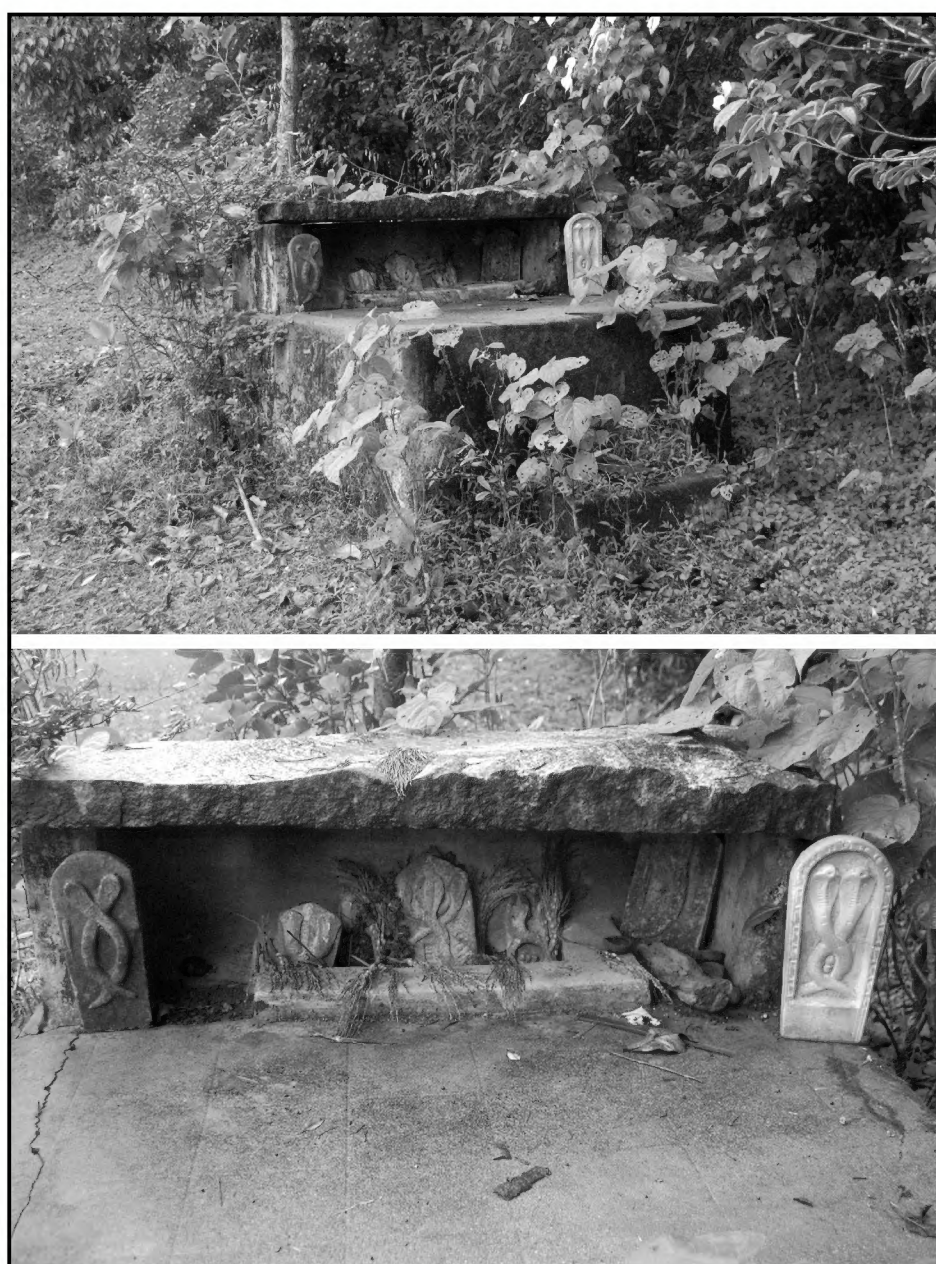


Figure 1. A cobra (Naga) shrine near the village of Agumbe in the Western Ghats of southwestern India, 2009 (Photographs by Thomas Rainwater).



Figure 2. Mount Popa, an extinct volcano in central Myanmar where a snake worshiping cult reputedly existed in the years before World War II (Photograph by Win Ko Ko).

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hamlet reportedly 6.5 km from Popa Village) as they collected hamadryads, which were said to “infest” the lowland forests surrounding the volcano. Villagers captured hamadryads by hand or with nooses suspended from long bamboo poles. After capturing a hamadryad, the handlers assured the Nats that no harm would come to the snake and promised to return it to the forest on a given day. Captured hamadryads were held for 10 days before being used in what Outram (1946) described as a “snake charming ceremony” conducted by a village “priestess.” The priestess applied a white, powdery make-up to her face and donned special loose-fitting traditional garments before interacting with the snakes. The ceremony began when the hamadryad was released; the snake immediately assumed an aggressive stance, spread its hood, and attempted to strike the priestess, who deftly avoided each downward lunge of the snake’s head. The ceremony reached a climax as the hamadryad tired, and culminated when the priestess leaned over and kissed the snake atop the head. The hamadryad was used for several performances, and then returned to the mountain and released. Because hamadryads were considered sacred animals, failure to release the snakes as earlier promised would mean certain death to the handler. Outram (1946) provided scant information on how this ceremony related to local religious beliefs or the practice of Nat worship other than stating hamadryads acted as guardians of Nat shrines on the mountain.

Another account of snake handling at Mount Popa is provided by Gillespie (1938) based on correspondence from Captain C. R. Douglas Gray, who photographed what are said to be “snake-charmers” engaged in a performance similar to that described by Outram (1946). According to Gray, hamadryads used in the performance had not been defanged and remained capable of delivering a potentially fatal bite. The snake handlers reportedly never kept “a king cobra for more than a year” and “in return for this consideration [the snakes] never bite them.” How the hamadryads were able to discern the future intentions of the snake handlers is left unstated. Gillespie (1938) suggested it was probably necessary to release the hamadryads after the snakes became accustomed to humans and no longer reacted aggressively during performances. Interestingly, Gray makes no mention of a connection between the performance and Nat worship, and the accompanying photographs show a large crowd gathered in what appears to be an entertainment venue, rather than a ceremonial or ritualistic milieu.

During a recent conservation assessment of Mount Popa National Park (Platt and Win Ko Ko, 2010), we queried a number of life-long residents in an effort to determine if a cobra cult still existed in the area. According to our informants, villagers worship *Anauk Medaw*, a female Nat believed to control the actions of venomous animals such as snakes, scorpions, and centipedes; proper propitiation of this Nat is thought to protect a person from envenomation. Additionally, a shrine to *Karli Medaw*, a many-handed Nat sheltered by two cobras, is found on Tuang Klat, an isolated pinnacle at the base of Mount Popa. However, we found no evidence for the continued persistence of rituals similar to those described by Outram (1946), and moreover, none of our informants were aware of the past existence of such a cobra cult in the area. Furthermore, in light of the brief account in Gillespie (1938), we cannot rule out the possibility

that Outram (1946) misinterpreted a form of public entertainment as a religious ritual. “Snake charming” has long been practiced in rural Burma and to a limited extent, continues today, often in association with pagoda festivals. Snake charmers are usually itinerant medicine sellers who handle venomous snakes to attract and entertain potential customers; upon completion of the performance, various medicines are proffered to the assembled crowd (Win Ko Ko, pers. obs.).

Another ritual involving hamadryads was described by Davis (1940) and Denis (1963). They witnessed it during a joint expedition to northern Myanmar and southern China immediately prior to World War II (Abbott, 1997). Neither author provided specific information on where the ritual was observed; reportedly a 19th century missionary named Hurston mentioned a “sacred hill of the snake,” describing it as a “bare black mountain” near the village of “Kensi” (Davis, 1940), and Armand Denis sponsored an expedition to locate the mountain and produce a cinematic travelogue (Abbott, 1997). After an arduous journey by vehicle and elephant, the expedition eventually located Kensi Village and succeeded in filming the ritual (Davis, 1940). The ritual was performed at a nearby cave inhabited by large hamadryads. Once every year hamadryads were captured elsewhere, transported to the cave, and released by a priestess who promised to return them to the forest 12 months later. The snakes were reportedly content to remain in the cave, and were provided with a regular supply of frogs to eat by the priestess (Davis, 1940). As described by Davis (1940), the ceremony began when the priestess entered the cave and then backed out slowly, laying bamboo mats before her, all the while uttering muffled incantations. Shortly a hamadryad estimated to be “14 feet long” (4.2 m) emerged from the cave, crawling along the trail of bamboo mats. Once in the open, the hamadryad struck repeatedly at the priestess who pinned and released it several times. The hamadryad pursued the priestess, at one point lunging forward and biting the folds of her skirt (Figure 3a). Eventually the hamadryad tired, and the priestess, praying in a subdued and soothing tone, leaned forward and kissed its mouth (Figure 3b), whereupon the snake slowly crawled back into the cave.

Although Davis (1940) provided photo-documentation of the snake ritual, its religious and cultural significance remain unclear. Indeed, several elements of the account seem fanciful and difficult to accept. For instance, Davis (1940) stated the large snakes were released into the cave and content to remain there while being fed a steady diet of frogs. First, we consider it unlikely that adult hamadryads would remain in a cave without being caged or otherwise confined in some way. Second, adult hamadryads subsist largely on snakes and lizards (Das, 2010), and to our knowledge anurans are not included in the diet. Third, the specific location where these observations reportedly occurred is vague, perhaps purposefully so, making verification difficult, if not impossible. Whether or not snake ceremonies persist in Shan State remains an open question as security concerns and travel restrictions preclude field research throughout much of this region.

Considerable speculation surrounds the origins of the snake ceremonies witnessed by travelers to pre-war Burma. Davis (1940) suggested Burmese “snake worship” had its genesis

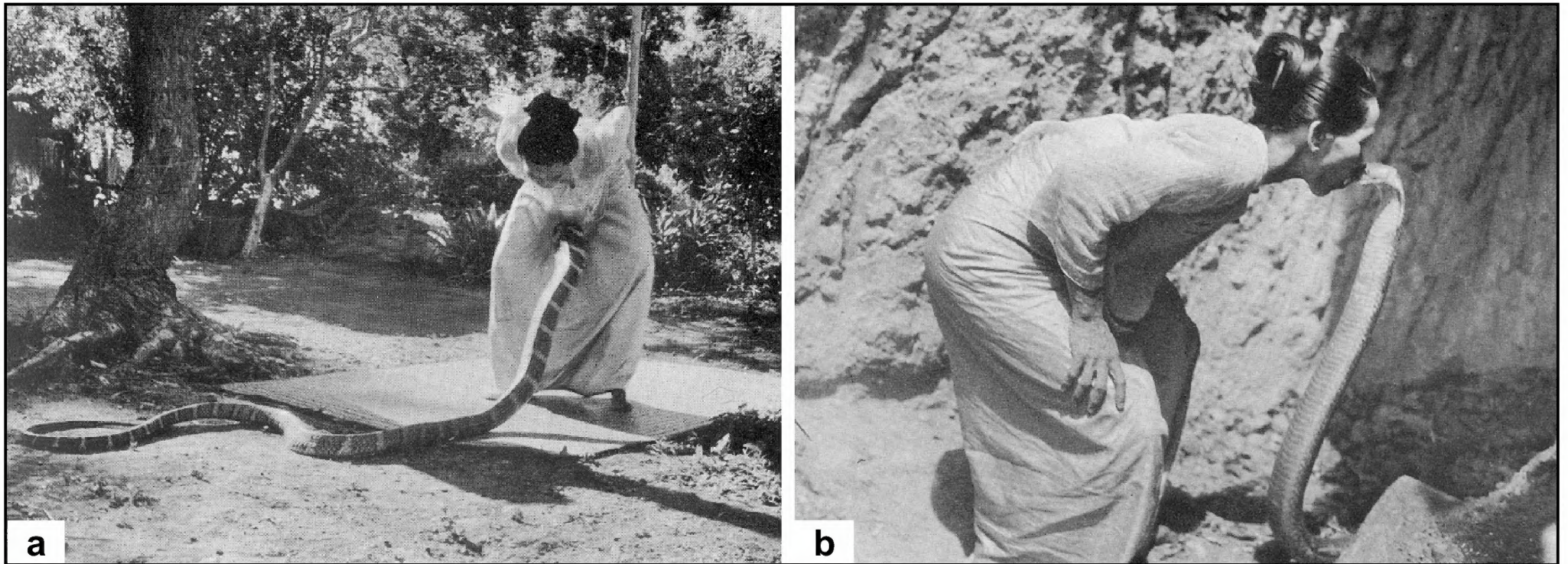


Figure 3. A ritual described as “snake worship” involving a large hamadryad (*Ophiophagus hannah*) and a local priestess. The ritual was reportedly filmed in Shan State, Myanmar, although the specific locality cannot be determined. During the ritual, a hamadryad lunges towards the priestess, biting the loose folds of her skirt (a). When the snake tires, the priestess leans forward, kissing its mouth and culminating the ritual (b). Photographs from Davis (1940).

either in India or among the Khmer rulers of ancient Cambodia and Thailand. The involvement of women in the Burmese rituals is apparently unique among ethnic snake charmers in the region, leading Minton and Minton (1980) to conclude their participation pointed to a Khmer origin, because Khmer kings claimed descent from a Naga princess who married an exiled Indian prince.

Owing to a lack of sufficient detail in the original accounts (Gillespie, 1938; Davis, 1940; Outram, 1946; Denis, 1963), the snake rituals of Burma are difficult to place in a religious or cultural context. Assuming these practices are indeed grounded in religious beliefs, we question their characterization as “snake worship” and propose an alternate interpretation. We contend it was the Nats rather than the snakes that were being worshiped; villagers probably believed the hamadryads were protected by local Nats, and viewed the rituals as a vehicle for appeasing the latter. We encountered similar rituals while conducting field research on tortoises (*Geochelone platynota* and *Indotestudo elongata*) in central Myanmar (Platt et al., 2003, 2011). In certain localized areas tortoises are believed to be under the protection of Nats associated with a nearby mountain or hill. To harm or even unduly disturb a tortoise is to risk offending the Nats and incurring divine retribution in the form of misfortune, sickness, and even death. Prior to initiating field surveys, we were asked by villagers to participate in ceremonies conducted by a local shamaness who made offerings to the Nats to con-

vince them of our good intentions. In this case (and probably with hamadryads as well), the Nats rather than the tortoises were the objects of veneration. The well-being of the tortoises was respected merely because these animals are believed to be favored by the Nats. However, because the historical record is largely silent on the cultural and religious significance of snake rituals, and these practices apparently no longer continue, the cobra cults of Burma are unlikely to ever be fully understood.

Acknowledgments

Our fieldwork in Myanmar was made possible through the generous support of Andy Sabin and the Sabin Family Foundation, and the Turtle Conservation Fund. Additional support for SGP was provided by a Faculty Research Enhancement Grant from the Department of Biology, Sul Ross State University, Alpine, Texas. Colin Poole, U Than Myint, U Saw Htun and the Wildlife Conservation Society–Myanmar Program have been instrumental in insuring the success of our field studies. TRR is grateful to Rom Whitaker for the invitation to visit Agumbe Rainforest Research Station (India) in 2009. We thank Michael Dloogatch for bringing a critical literature reference to our attention. Linda Epps and the interlibrary loan staff at Sul Ross State University assisted with obtaining several other obscure literature references. Kalyar Platt and Lewis Medlock are thanked for critically reviewing an initial draft of this manuscript.

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Notes on the Herpetofauna of Western Mexico 6: Amphibians and Reptiles of Hostotipaquillo, Jalisco, Mexico

Edgar Flores-Cobarrubias¹, Daniel Cruz-Sáenz^{2,3} and David Lazcano³

Abstract

Sampling of amphibians and reptiles was conducted in the municipality of Hostotipaquillo in the northern part of the state of Jalisco. After six months of fieldwork 60 species were registered. This field work was conducted to determine the previously undocumented species richness of the municipality.

Resumen

Se realizó el muestreo de herpetofauna en el municipio de Hostotipaquillo en el estado de Jalisco con la finalidad de incrementar el conocimiento en cuanto a la riqueza de estos grupos. Después de seis meses de muestreo se registraron 60 especies. Este trabajo se realizó con la finalidad de dar a conocer la diversidad de anfibios y reptiles de este municipio poco conocido.

Introduction and Background

Mexico is recognized for its richness in amphibian and reptile species, and Jalisco contributes an important number of species to this diversity. It is seventh out of 32 states in terms of herpetofaunal richness, with circa 200 species of amphibians and reptiles (Cruz-Sáenz et al., 2009a). Tropical deciduous forest is the biome with the highest richness in reptiles in Jalisco (Cruz-Sáenz, 2009b). The state is politically divided into 125 municipalities. A number of important papers have been published on Jalisco's herpetofauna: Casas-Andreu (1982) and García and Ceballos (1994) surveyed the herpetofauna of the coastal area of the state, and Ramírez-Bautista (1994) worked in the area of Chamela-Cuixmala Biosphere Reserve.

Documenting Mexico's herpetological richness has received increasing attention in recent years with the publication of numerous scientific articles and books, including: amphibians and reptiles of Aguascalientes (Vázquez-Díaz and Quintero-Díaz, 2005); amphibians and reptiles of Coahuila (Lemos-Espinal and Smith, 2007a); amphibians and reptiles of Chihuahua (Lemos-Espinal and Smith, 2007b); herpetofauna of Valle de México (Ramírez-Bautista et al., 2009); the Bufonidae of Mexico (Oliver-López et al., 2009); snakes of Nuevo León (Lazcano et al., 2010); biodiversity of Sonora (Molina-Freaner and Van Devender, 2010); amphibians and reptiles of Valle de Tehuacán-Cuicatlán (Canseco-Márquez and Gutiérrez-Mayén, 2010); amphibians and reptiles of Querétaro (Dixon and Lemos-Espinal, 2010). Many of the herpetological activities conducted in the country are documented in the abstracts of the Mexican Herpetological Society meetings that have occurred since the early '80s, including 2006 (Monterrey), 2008 (Pachuca), 2010 (Toluca).

The Santiago River which crosses the southern part of the municipality of Hostotipaquillo has been impacted by a series of hydroelectric plants: Aguamilpa (1994); El Cajón (2007) in Nayarit and Santa Rosa (1964); La Yesca (2012) in Jalisco,

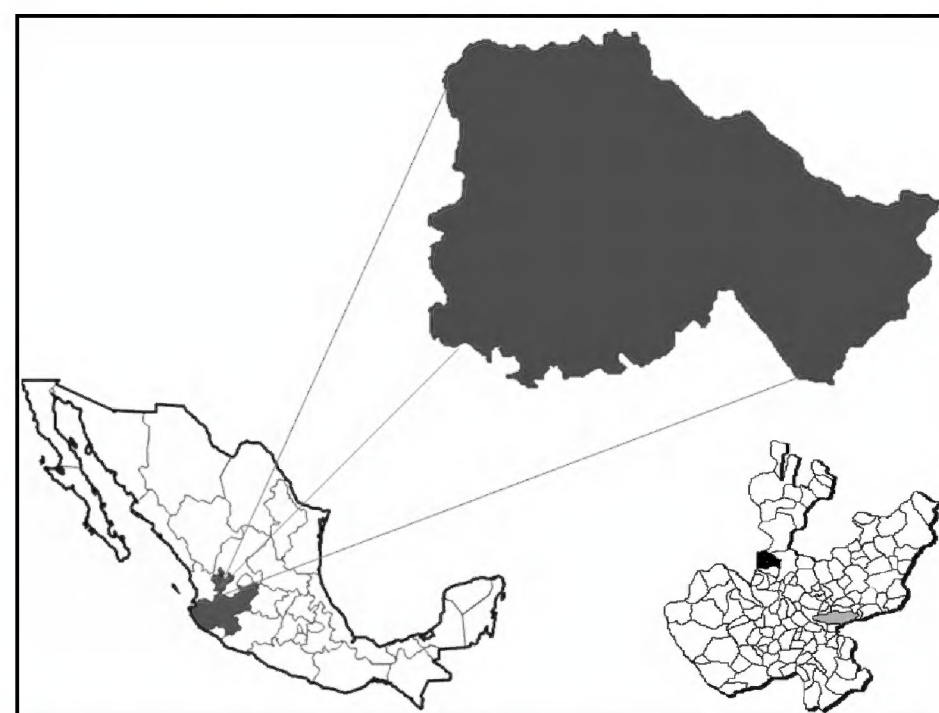
interrupting its flow to the Pacific Ocean.

In this article we contribute to our better understanding of Jalisco herpetofauna, extending our knowledge on herpetological patterns of distributions throughout the state. We include a checklist of our study site in the municipality of Hostotipaquillo.

Understanding the vertebrate diversity at the site is important for management and conservation actions, issues and programs. It may extend our number of areas dedicated the preservation and conservation of species that could fall in any category within the Mexican Wildlife Laws.

Study Area

The municipality of Hostotipaquillo is located in the northern region of Jalisco, with a surface area of 697.94 km², which represents 0.969% of Jalisco's territorial surface. It's about 100 km from Guadalajara, traveling on the Federal Highway #15; the study area is bordered by the municipalities of Tequila to east



Location of the municipality of Hostotipaquillo.

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A view of tropical deciduous forest in the valley of the Santiago River. Photograph by Daniel Cruz-Sáenz.

and Magdalena to the south in Jalisco. The Santiago River is a natural border between the municipalities of Hostotipaquillo/Magdalena and the municipality of Ixtlán del Río in Nayarit to the west. By the time the river crosses these municipalities it has been impacted by Hydroelectric Plant La Yesca located between the municipalities of La Yesca (Nayarit) and Hostotipaquillo (Jalisco).

Hostotipaquillo has several vegetation types: tropical deciduous forest, thorn scrub, oak forest, pine-oak forest, natural and induced grasslands, secondary vegetation and agricultural lands. The dominant vegetation is the tropical deciduous forest (INEGI, 1981).

Methods

Our survey was conducted for a period of six months in the different vegetation types of the municipality of Hostotipaquillo, Jalisco. Before starting our survey we checked for previous herpetological documentation/articles/databases of the municipality. The selection of sites were made using a grid and randomizing the squares of the grid. This divided the municipality into measurable squares that were used as transects of one km².

In each transect we surveyed in all the probable microsites



A juvenile *Ctenosaura pectinata*. Photograph by Daniel Cruz-Sáenz.



An oak forest in the municipality of Hostotipaquillo, Jalisco. Photograph by Daniel Cruz-Sáenz.

that amphibians and reptiles could use or be found in: logs, rocks, trees, ground, leaf litter, anthropogenic cover, etc.

Results

Our surveys provide additional baseline distribution data for the diversity of amphibians and reptiles of municipality of Hostotipaquillo. The documented herpetofauna consists of 60 species, of which 20 are amphibians and 40 are reptiles (see Table 1). Four had been previously reported (Cruz-Sáenz, 2004): *Lithobates catesbeianus*, *Lithobates berlandieri*, *Coluber flagellum* and *Trimorphodon biscutatus*.

Amphibian species were grouped in one order, six families and 11 genera. Of these, 10 species are endemic to Mexico and four are protected by the Mexican law NOM-SEMARNAT-059-2010.

Reptile species were grouped in two orders, 14 families and 26 genera. Of these, 18 species are endemic to Mexico and 16 are protected by the Mexican law NOM- SEMARNAT-059-2010.

The families that present the largest number of species of amphibians are Ranidae and Craugastoridae, and of reptiles are Colubridae and Phrynosomatidae.



Crotalus basiliscus taking refuge in a rocky canyon. Photograph by Daniel Cruz-Sáenz.

Table 1. Amphibian and reptile species from Hostotipaquillo. Protection categories based on Norma Oficial Mexicana (NOM-SEMARNAT-059-2010): A = Amenazada (Threatened), P = En Peligro (Endangered), Pr= Protección Especial (Special concern). Endemism status: EM= Endemic to Mexico. Empty circles○ indicate species previously recorded. Filled circles ● are records from this project. Nomenclature from Flores-Villela and Canseco-Márquez (2004) and Liner and Casas-Andreu (2008).

Species	Common name	Protection category	Endemism	Record
Amphibians				
<i>Ollotis mazatlanensis</i>	Sinaloa Toad	—	EM	●
<i>Ollotis occidentalis</i>	Pine Toad	—	EM	●
<i>Rhinella marina</i>	Cane Toad	—	—	●
<i>Syrrophus modestus</i>	Blunt-toed Chirping Frog	Pr	EM	●
<i>Syrrophus nitidus</i>	Shiny Peeping Frog	—	EM	●
<i>Craugastor augusti</i>	Barking Frog	—	EM	●
<i>Craugastor hobartsmithi</i>	Smith’s Pigmy Tropical Frog	—	EM	●
<i>Craugastor occidentalis</i>	Taylor’s Barking Frog	—	EM	●
<i>Hyla arenicolor</i>	Canyon Treefrog	—	—	●
<i>Hyla eximia</i>	Mountain Treefrog	—	—	●
<i>Pachymedusa dacnicolor</i>	Mexican Leaf Frog	—	EM	●
<i>Smilisca baudinii</i>	Mexican Treefrog	—	—	●
<i>Smilisca fodiens</i>	Lowland Burrowing Treefrog	—	—	●
<i>Spea multiplicata</i>	Mexican Spadefoot	—	—	●
<i>Hypopachus variolosus</i>	Sheep Frog	—	—	●
<i>Lithobates berlandieri</i>	Rio Grande Leopard Frog	—	—	○
<i>Lithobates catesbeianus</i>	American Bullfrog	—	—	○
<i>Lithobates forreri</i>	Forrer’s Leopard Frog	Pr	—	●
<i>Lithobates megapoda</i>	Big-footed Leopard Frog	Pr	EM	●
<i>Lithobates neovolcanicus</i>	Transverse Volcanic Leopard Frog	A	EM	●
Reptiles				
<i>Elgaria kingii</i>	Madrean Alligator Lizard	A	—	●
<i>Phyllodactylus lanei</i>	Lane’s Leaf-toed Gecko	—	EM	●
<i>Phyllodactylus tuberculosus</i>	Yellow-bellied Gecko	—	—	●
<i>Ctenosaura pectinata</i>	Western Spiny-tailed Iguana	A	EM	●
<i>Heloderma horridum</i>	Beaded Lizard	A	—	●
<i>Sceloporus albiventris</i>	White-bellied Spiny Lizard	—	EM	●
<i>Sceloporus clarkii</i>	Clark’s Spiny Lizard	—	—	●
<i>Sceloporus heterolepis</i>	Odd-scaled Spiny Lizard	—	EM	●
<i>Sceloporus horridus</i>	Rough Lizard	—	EM	●
<i>Sceloporus melanorhinus</i>	Black-nosed Lizard	—	—	●
<i>Sceloporus scalaris</i>	Light-bellied Bunchgrass Lizard	—	—	●
<i>Sceloporus utiformis</i>	Large-scaled Spiny Lizard	—	EM	●
<i>Urosaurus bicarinatus</i>	Tropical Tree Lizard	—	EM	●
<i>Norops nebulosus</i>	Clouded Anole	—	EM	●
<i>Aspidoscelis communis</i>	Giant Whiptail	Pr	EM	●
<i>Aspidoscelis costata</i>	Western Mexico Whiptail	Pr	EM	●
<i>Aspidoscelis gularis</i>	Texas Spotted Whiptail	—	—	●
<i>Aspidoscelis lineatissima</i>	Many-lined Whiptail	Pr	—	●
<i>Plestiodon callicephalus</i>	Mountain Skink	—	—	●
<i>Boa constrictor</i>	Boa Constrictor	A	—	●
<i>Coluber bilineatus</i>	Sonoran Whipsnake	—	—	○
<i>Coluber flagellum</i>	Coachwhip	A	—	●

Table 1 (cont'd)

Species	Common name	Protection category	Endemism	Record
<i>Coluber mentovarius</i>	Neotropical Whipsnake	—	—	●
<i>Drymarchon melanurus</i>	Central American Indigo Snake	—	—	●
<i>Drymobius margaritiferus</i>	Speckled Racer	—	—	●
<i>Hypsiglena torquata</i>	Collar Nightsnake	Pr	—	●
<i>Lampropeltis triangulum</i>	Milksnake	A	—	●
<i>Manolepis putnami</i>	Thin-scaled Snake	—	EM	●
<i>Pantherophis emoryi</i>	Great Plains Ratsnake	—	—	●
<i>Oxybelis aeneus</i>	Brown Vinesnake	—	—	●
<i>Salvadora mexicana</i>	Mexican Patch-nosed Snake	Pr	EM	●
<i>Tantilla bocourti</i>	Bocourt's Black-headed Snake	—	EM	●
<i>Tantilla calamarina</i>	Pacific Coast Centipede Snake	Pr	EM	●
<i>Thamnophis cyrtopsis</i>	Black-necked Gartersnake	A	—	●
<i>Trimorphodon biscutatus</i>	Western Lyresnake	Pr	—	○
<i>Trimorphodon tau</i>	Mexican Lyresnake	—	EM	●
<i>Micrurus distans</i>	Western Mexican Coral Snake	Pr	EM	●
<i>Crotalus basiliscus</i>	Mexican West Coast Rattlesnake	—	EM	●
<i>Ramphotyphlops braminus</i>	Brahminy Blindsnake	—	—	●
<i>Kinosternon integrum</i>	Mexican Mud Turtle	Pr	EM	●

Discussion

This project increased the documented herpetological richness of the municipality to 60 species.

A great number of species are under a protection regime (20) and many (28) are endemic to Mexico. It is important to continue fieldwork in order to determine the conservation status of populations that inhabit this municipality and to implement actions conducive to the preservation of all herpetofauna (Cruz-Sáenz, 2004).

Even though the municipality is bordered to the south by the Santiago River, which has been impacted by a hydroelectric plant, the positive or negative effects on herpetofauna have not been quantitatively evaluated here or in any part of Mexico, as they have been in other countries (Dettman 2005; Iftime 2005; Brandão and Araújo, 2008; Hayes and Jennings, 1986; Jennings, 1988; Lind et al., 1996; McLeod et al., 2011; Moyle, 1973).

Dams are very important sources of electric power that benefits a large number of people; their construction is a vital strategy for any nation. To the states of Jalisco and Nayarit the effects of dams on wildlife come in second when human population is at stake. Dams will probably continue being built; this is something essential for our nation. We should do our best to construct more dams that are in harmony with the environment and provide ecological services. Enhanced water reserves are an indirect effect of dams. They may also supply water for irrigation, direct human consumption and ecotourism.

Acknowledgments

We thank Efrain Flores Castañeda for support in the field, and the administration of the H. Ayuntamiento de Hostotipaquillo, Jalisco, for their economic support in developing this project. And we thank Robert Bezy for helpful suggestions.



Sceloporus utiformis. Photograph by Daniel Cruz-Sáenz.



Pachymedusa dacnicolor. Photograph by Daniel Cruz-Sáenz.

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Bull. Chicago Herp. Soc. 47(2):26, 2012

A Brief Note on Reproduction in Morelet's Leaf Frog, *Agalychnis moreletii* (Duméril)

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Fecundity levels are highly variable among amphibians and are most closely associated with reproductive modes and body size within reproductive modes (Duellman and Trueb, 1986). The phyllomedusine hylids of the genus *Agalychnis* are often explosive breeders; during favorable conditions they frequently congregate en masse, depositing clutches of eggs on vegetation and rocks above bodies of water. Hatching tadpoles later fall into the water to complete their development. Among the *Agalychnis* species, reported clutch sizes are 11–108 eggs in *A. callidryas*, 47–162 eggs in *A. annae*, 14–67 eggs in *A. spurrelli*, 23–85 eggs in *A. moreletii*, and 21–79 in *A. saltator* (Duellman, 2001). These numbers don't necessarily reflect, however, the total reproductive output of a female over the course of one evening. In a recent study in Belize, Briggs (2007) found that females typically produce a number of "sub-clutches" while in amplexus with a single male. After each sub-clutch is deposited, the female will descend to the water to refill her bladder before laying the next complement of eggs. The number of eggs deposited in one evening from these sub-clutches may total 200–250 eggs in *A. callidryas* and 300–350 eggs in *A. moreletii* (Briggs, 2007).

Morelet's or black-eyed leaf frogs (*A. moreletii*) are moderately large (to 82.9 mm) hylids distributed from southern Mexico to central El Salvador. Inhabiting humid lowland to montane forests (450–2130 m), *A. moreletii* occurs in both pristine and disturbed habitat, and individuals are generally found during the day on the surfaces of leaves (Campbell, 1998; Duellman, 2001). It is considered critically endangered and has recently been afforded CITES protection under Appendix II.

On 29 May 2010, a captive 78 mm female *A. moreletii* deposited a total of 359 eggs in what appeared to be a composite of several successively laid and adjoined "sub-clutches" adhered to the side of a large glass enclosure. Clutch size was later determined by counting the number of tadpoles (332) found in the water below and then counting infertile eggs (27) left in the gelatinous egg mass. Another clutch deposited in August 2010 by an *A. moreletii* was estimated to have numbered over 200 eggs, many of which were infertile. These observations provide further evidence that the reproductive potential of this species over the course of a single evening may be particularly higher than what single clutch counts might suggest.

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Herpetology 2012

In this column the editorial staff presents short abstracts of herpetological articles we have found of interest. This is not an attempt to summarize all of the research papers being published; it is an attempt to increase the reader's awareness of what herpetologists have been doing and publishing. The editor assumes full responsibility for any errors or misleading statements.

PROTECTING BLANDING'S TURTLES

J. D. Congdon et al. [2011, Canadian Journal of Zoology 89(11):1098-1106] documented sizes of terrestrial protection zones around wetlands that are necessary to protect all of the core area of Blanding's turtles (*Emydoidea blandingii*) on the Edwin S. George Reserve (ESGR) in southeastern Michigan. Data collected over three decades indicated that 39% of the 83 females and 50% of the 60 males maintained the same residence wetland for more than 20 years, and 33% of the 182 nonresident females used nesting areas on the ESGR for more than 20 years. Approximately 20% of resident males and females were captured in 21 temporary wetlands on the ESGR. Nesting areas were located from 100 to 2000 m from residence wetlands, and some of 45 females (18%) used up to six different nesting areas, some separated by >1000 m. Terrestrial protection zones 300 and 450 m around all wetlands (residence and temporary) protect 90% and 100% of nests, respectively. Terrestrial protection zones of 300, 1000, and 2000 m around residence wetlands only are required to protect 14%, 87%, and 100% of adults, respectively. A protection zone that encompasses the activities of most or all Blanding's turtles has a high probability of including the core areas of most other semiaquatic organisms.

ROAD SALT AND TREEFROG TADPOLES

E. K. Dobbs et al. [2012, Herpetologica 68(1):22-30] note that salinization of aquatic habitats is an emerging environmental concern, especially in colder climates where salt is used to prevent road icing during winter months. Salt applied to roads is carried into aquatic environments in storm-water runoff, where fluctuating water levels can result in salt stratification and spatially complex exposure scenarios for embryonic and larval pond-breeding amphibians. The authors experimented to investigate the potential interaction between oviposition site selection and toxicity of road salt to embryonic Cope's gray treefrogs (*Hyla chrysoscelis*). They simulated road-salt stratification in 7-liter microcosms containing sediment from a salt-contaminated pond and placed developing eggs at three water depths and directly on the sediment of the microcosms. At the beginning of the experiment, conductivity at the bottom of the microcosms was four to seven (from 4.0 to 6.5 mS cm⁻¹) times higher than at the top or middle of the water column (1.0 mS cm⁻¹). Subsequently, survival of eggs placed near the bottom and on the bottom of buckets containing salt-contaminated sediment was near 0%, while survival of eggs at the top and middle depths of the contaminated microcosms, and at all depths in control microcosms, was >60%. After hatching, embryos avoided the bottom of contaminated buckets even though much of the vertical salt gradient had dissipated. In contrast, embryos in control buckets clustered at the bottom. These results suggest that pond-breeding amphibians that place their eggs away from the bottom may avoid some of the toxic effects of salt contamination, and those that place eggs on the bottom may be at particularly high risk.

SALTIES EATING SEA TURTLES

S. D. Whiting and A. U. Whiting [2011, Chelonian Conservation and Biology 10(2):198-205] describe predation tactics used by saltwater crocodiles (*Crocodylus porosus*) on flatback sea turtles (*Natator depressus*) and olive ridley sea turtles (*Lepidochelys olivacea*) on nesting beaches in northern Australia. For adult turtles, crocodiles used both a sit-and-wait tactic in which they attacked a turtle at the water's edge after it completed nesting and an active hunting strategy in which crocodiles followed turtle tracks into the dunes to attack turtles at nest sites. Saltwater crocodiles also hunted sea turtle hatchlings in the dunes and excavated a sea turtle nest and consumed the eggs. The protection of saltwater crocodiles in Australia starting in the early 1970s has led to increased population sizes and a greater proportion of larger individuals. This likely has resulted in increased predation rates on sea turtles over several decades, which should be considered as an important mortality component for some tropical nesting aggregations.

TADPOLE BUOYANCY

J. H. Gee and S. L. Rondeau [2012, Herpetologica 68(1):3-13] measured gaseous lift and specific gravity of larval anurans at regular intervals during development to assess their importance in determining buoyancy in eight species. Specifically, they examined the hatchling, larval, and metamorphic stages of tadpoles from still waters (*Limnodynastes dumerili*, *Limn. peronii*, *Lithobates septentrionalis*, and *Rhinella marina*), intermittent streams (*Litoria genimaculata* and *Lito. lesueuri*), and torrent sections of rivers (*Lito. nannotis* and *Nyctimystes dayi*). Buoyancy levels and the strategies used to attain buoyancy varied at different phases of development and with the environment occupied. Buoyancy increased rapidly during development in hatchlings of *Limn. peronii*, *Lith. septentrionalis*, and *R. marina* due to a reduction in specific gravity. Lungs were inflated in early larval stages of all species except for *Lito. nannotis*, *N. dayi*, and *R. marina*, which inflated their lungs following metamorphosis. *Limnodynastes dumerili* and *Limn. peronii* used gaseous lift to maintain near-neutral buoyancy throughout larval and metamorphic stages. *Lithobates septentrionalis*, Stages 25–29 (first summer), possessed a high level of gaseous lift, but buoyancy declined as lung gas volume decreased in Stages 31–43 (second summer). *Rhinella marina* did not inflate lungs prior to transformation but achieved an intermediate buoyancy level due to a very low specific gravity. The intermittent-stream species *Lito. genimaculata* and *Lito. lesueuri* used gaseous lift to achieve buoyancy levels similar to those of *Lith. septentrionalis* (Stages 31–43) and *R. marina*. The torrent-dwelling species *Lito. nannotis* and *N. dayi* were the least buoyant; their lungs were not inflated prior to transformation and their specific gravity was elevated. Both gaseous lift and specific gravity are important factors in determining buoyancy in larval anurans.

SALT TOLERANCE BY CRAB-EATING FROGS

W.-T. Hsu et al. [2012, *Herpetologica* 68(1):14-21] report that previous studies have shown that the tadpoles of crab-eating frogs, *Fejervarya cancrivora*, were salt-tolerant (up to 24 parts per thousand [ppt] in the field and 35 ppt in the laboratory) but metamorphosed only at or below 6.6 ppt. They hypothesized that the discrepancy in salt tolerance is due to results drawn from short- and long-term experiments and different acclimation procedures, which needed to be re-examined. They compared the salinity tolerance of acclimated and nonacclimated tadpoles and assessed salinity effects on growth, development and metamorphosis among tadpoles of *F. cancrivora* throughout the larval period. Experiment 1 determined 48-h tadpole survivorship by assigning 40 tadpoles to one of 24 treatments ranging from 3-ppt to 30-ppt salinity. Experiment 2 assigned tadpoles to 3- to 15-ppt salinity at intervals of 3 ppt and monitored growth and development. Experiment 3 exposed 15 tadpoles to a stepwise increase of salinity (2 ppt every 3 d) and monitored the tadpole survivorship and metamorphic success. Experiment 1 estimated LC_{50} (the salt concentration that kills 50% of tadpoles within 48 h) at 13.7 ppt and tadpoles survived for 48 h at salinities as high as 16 ppt, suggesting that saline tolerance of *F. cancrivora* tadpoles is greater than any other anuran species studied to date. In Experiment 2 only tadpoles in 3, 6, and 9 ppt survived to metamorphosis. Tadpoles at 9 ppt grew and developed slower than in lower salinities during the first 7 wk, but the time to and size at metamorphosis were similar among treatments, suggesting that tadpoles were stressed at 9 ppt early, but probably were able to catch up growth after a period of adjustments. In Experiment 3 all tadpoles survived through 18 d as the salinity was increased stepwise from 3 ppt to 15 ppt, and 6 of 15 tadpoles were able to metamorphose at high salinities (17–21 ppt). This contradicts earlier results suggesting tadpoles could metamorphose only at salinities ≤ 6.6 ppt. Overall results showed that *F. cancrivora* tadpoles not only tolerate salt well, but also can acclimate to higher salinities. This ability to acclimate could free tadpoles from dependence on the occurrence of rain to facilitate metamorphosis, and thus represents an adaptation to the unpredictable nature of salinity variation in brackish habitats.

A NEW SPECIES OF CHAMELEON

E. Greenbaum et al. [2012, *Herpetologica* 68(1):60-75] note that the recently erected chameleon genus *Kinyongia* currently includes 17 species, with the majority occurring in montane regions of East Africa. *Kinyongia adolfifriederici* is one of only three species in the genus to occur in Central Africa, with numerous populations occurring from low- to high-elevation forests of the Albertine Rift. Recent fieldwork in the Lendu Plateau in northeastern Democratic Republic of the Congo (DRC) led to the discovery of a population of chameleons that is significantly larger than and morphologically distinct from the closely related species *K. adolfifriederici*, which was described from the lowland Ituri forest, DRC. Analyses of mitochondrial and nuclear DNA sequences revealed that *K. adolfifriederici* is a complex of cryptic species. The authors describe the Lendu population as a new species, *Kinyongia gyrolepis*, underscoring the endemism and conservation importance of this poorly known, unprotected montane region.

GREEN SEA TURTLES IN SAN DIEGO BAY

T. Eguchi et al. [2012, *Herpetologica* 68(1):76-87] studied morphology and somatic growth rate of green sea turtles, *Chelonia mydas*, living in San Diego Bay, California; one of the northernmost foraging areas for the species in the eastern Pacific. A power plant had discharged heated effluent into the urbanized bay from 1960 to 2010. Straight carapace lengths of 101 green sea turtles were recorded from 31 March 1990 to 15 April 2011 (45.4 to 110.4 cm). Green sea turtles in San Diego Bay were morphologically indistinguishable from those foraging in Baja California Sur, Mexico. The median growth rate was 1.03 cm/yr (-1.6 to 11.4 cm/yr) for all turtles and was 4.9 cm/yr for turtles ≤ 90 cm. These growth rates were one of the fastest for the species in temperate areas and comparable to those reported for tropical regions. Based on behavioral observations and information from other diet studies, the authors think that the altered environment from the power plant effluent affected the growth of the green sea turtles directly (longer active periods) and via shifts in the environment (changes in prey composition, abundance, and distribution). With the termination of the power plant operation at the end of 2010, the ecosystem is reverting to its natural state, which the authors expect will result in decreased growth rates of these turtles in the coming years.

GRASS SNAKE POPULATION DIFFERENTIATION

B. Meister et al. [2012, *Herpetologica* 68(1):134-145] note that the loss and fragmentation of pristine habitat restrict specialized species to remnants of original habitat patches in a less suitable landscape. This may lead to a genetic differentiation of the subpopulations and to a decline in biodiversity. Seven microsatellite markers were used to examine the genetic population structure of grass snakes, *Natrix natrix*, sampled in remnants of pristine habitat in a former wetland in the Swiss lowlands and in a rural valley in the Alps. On a regional level, the population structures of *N. natrix* in these two areas were compared with that of grass snakes living in an intensively used agricultural area. The three study areas were 30–100 km apart, but were interconnected by the river Aare. At the local scale, no genetic differentiation was found in either of the *N. natrix* populations inhabiting the rural alpine valley or the intensively used agricultural area. However, two subpopulations in the former wetland area were genetically differentiated with low but significant differentiation between them. This slight differentiation can be explained by isolation by distance. At the regional scale, significant genetic differentiation was found between *N. natrix* populations inhabiting areas separated by 30–100 km. Genetic structure was highly related to isolation by distance with 85% of the among-populations genetic variance explained by the geographical distance. Euclidean distance explained genetic differentiation of grass snake populations better than distance following watercourses. These findings indicate regular gene flow between *N. natrix* subpopulations and show that this species also moves across intensively used terrestrial habitat. The genetic structure of grass snakes is mainly affected by geographic distance, while human activity and habitat alteration do not seem to reduce the snakes' movements. The results suggest that conservation in human-altered landscapes should focus on the maintenance of a habitat mosaic with anuran breeding ponds and adequate oviposition sites.

The Tympanum

When People Ask Why You Keep Reptiles, Tell Them

Every reptile keeper is familiar with it: Total incomprehension on the part of non-herpers as to why we keep the pets we do.

While others are off in Washington doing their work fighting this battle on the legislative front, the rest of us have our own battles to fight. I issued a **challenge to the members** of the reptile community in December to do education in libraries, schools, and public events like pet fairs, but we also need to do one-on-one education about the beauty and wonder of our chosen species.

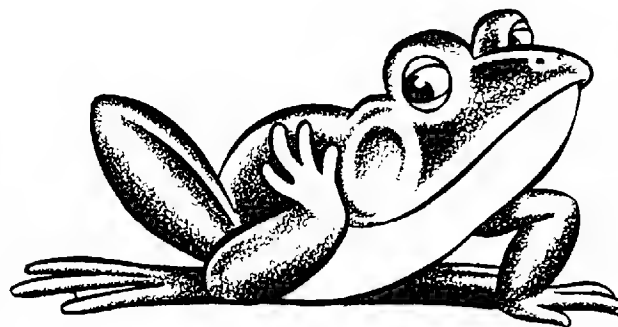
Start by sharing with skeptical members of the public how beautiful you find animals like snakes. Their fluid movements, grace, and beauty enthrall me each and every day I am with them. Their bodies are amazing mechanically; their muscle movements enchant me.

We need to help people understand that yes, we have relationships with our snakes. I talk to each one that lives with me, calling them by name even though they never answer back. These are beautiful, low maintenance pets who make me smile each day; what could be wrong with that?

My lizards are much more personable. Osama answers to his name and is clearly my favorite. He greets me with a series of head-bobs communicating his mood, much like a dog does with his tail.

I train my dogs, and I've also trained my lizards. Using treats to reward the behavior I want, I have successfully trained Osama to go where I want him to and remain hands free if I wish. He responds to my voice, not in the same way as my dogs, but in his own way. It's clear he recognizes my voice. He also responds to my touch and often reaches out to be held.

No, my reptiles don't follow me around the house like my dogs. They don't share scraps off my plate or cuddle with me on the couch—but neither does my cat.



You may think you shouldn't have to explain to people that your pets are great animals and that you aren't a "freak" for keeping them. You're right; in a perfect world, that would be true. But in case you haven't noticed, this isn't a perfect world, and the more we get average pet-owners to understand that we love, respect and admire our reptile pets, the easier it will be to get them to oppose laws that would take our



Cindy with Osama Binguana, her beloved Grand Cayman hybrid iguana.

pets away or irrationally restrict our right to keep them, or to share this wonderful hobby with another generation of herpers.

So the next time you tell someone you keep snakes and they say, "Euwww," don't argue with them; educate them. Start today.

Cindy Steinle [This opinion piece first appeared in Cindy's blog for February 1, 2012, on Kingsnake.com. For more of Cindy's blogs see <http://www.kingsnake.com/blog/authors/7-Cindy-Steinle>]

Unofficial Minutes of the CHS Board Meeting, January 13, 2012

The meeting was called to order at 7:45 P.M. at the Schaumburg Public Library. Board member Deb Krohn absent.

Officers' Reports

Recording Secretary: The December 2011 minutes were read, corrected, and accepted.

Treasurer: The December financial report was presented, discussed and accepted.

Membership Secretary: Mike Dloogatch reported a modest increase in membership over 2011.

Sergeant-at-arms: Greg Brim counted 56 people at the November meeting.

Publications Secretary: Aaron LaForge is working on a calendar of events for the CHS website.

Sergeant-at-arms: Jim Foster reported that the attendance at the December holiday meeting was 76.

Committee Reports

Shows:

- Notebaert, first full weekend of each month
- Chicago Kids Expo, March 3,4
- Project Exploration Dino Dinner, March 9
- Reptile Rampage, Lake Forest, March 11
- Family Pet Expo, Arlington Racetrack, March 16–18
- NARBC Tinley Park, March 17 & 18

Grants: There are many good applications. The committee will meet this month to review them. Mike Dloogatch moved to increase to \$10,000 the amount available to the committee for grant awards in 2012. Lawrence seconded the motion. Discussion emphasized that the full amount available does not have to be used by the committee. The motion passed unanimously.

Old Business

NARBC, Tinley Park: Jason has confirmed that we will have a free table..

Extra General Meeting, June 9: Cindy and Jason are still working on confirmation. Location and speaker info will be in place by February. Promotion will need to start soon

New Business

March board meeting: Because of the show schedule in March, the date of the board meeting has been changed to March 23, and may be held at Wildlife Discovery Center, pending approval.

Closing ReptileFest early on Sunday: A suggestion was made to close fest at 4 on Sunday. After discussion, it was decided to leave the closing time at 5.

Update 'Fest contact list on the website: Aaron will update.

Jason will not be at the February board meeting. Cindy will run the meeting.

Update contact page on website: Aaron will get contact info for new board members up on website.

Jim Foster needs to know the contact info for the person at the Notebaert to whom to report our meeting attendance.

All current board members should have received an invitation to join a Google Group to receive emails.

Donations: The board discussed donating money to other organizations, since 2011 was a good financial year for us. Tabled until May to see how successful 'Fest is. Anyone wishing to submit an organization for consideration should talk to a board member before the May board meeting.

Round Table

Aaron and his wife are expecting their second child this year.

Bobby Delaney has an internship in graphic design with *Herp Nation* magazine.

J.T. Turingan last year at 'Fest heard *Chicago Parent* most often named as the source of info on 'Fest.

Jenny mentioned an article in the *Chicago Tribune* quoting Steve Sullivan.

Mike Dloogatch passed around a newsletter from the Friends of Kankakee stating they had a great year in land acquisition.

Barb Khan saw interesting things on Yahoo: a new snake species and the world's smallest frog.

Lawrence—Herps of the month: January: turtles and tortoises; February: herps in love; March: green herps; April: herp eggs.

Mike Scott: 92 days 'til 'Fest!

Jason urged everyone to check the Facebook page to sign the US ARK petition to stop the new additions to the Lacey Act list of injurious wildlife.

The meeting was adjourned at 9:12 P.M.

Respectfully submitted by recording secretary Jenny Vollman



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For sale: rats and mice—pinkies, fuzzies and adults. Quantity discounts. Please send a SASE for pricelist or call Bill Brant, *THE GOURMET RODENT*, PO Box 430, Newberry, FL 32669-0430, 352-472-9189, E-mail: GrmtRodent@aol.com.

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Line ads in this publication are run free for CHS members — \$2 per line for nonmembers. Any ad may be refused at the discretion of the Editor. Submit ads to mdloogatch@chicagoherp.org.



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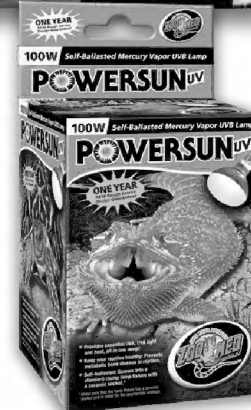
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News and Announcements

2012 CHS GRANT RECIPIENTS

The CHS Grants Committee has chosen the CHS grant recipients for 2012. The committee consisted of John Archer, Michael Dloogatch, Jason Hood, Linda Malawy, Cindy Steinle, Amy Sullivan and Steve Sullivan. This year we received 27 applications, as usual exceeding the number of grants that could be awarded based on available funds. After a difficult decision process, 12 grants were awarded, in varying amounts, as follows:

- Stacy Beyer, Department of Natural Resources and Environmental Sciences, University of Illinois at Urbana-Champaign. “Role of Forests in the Landscape Epidemiology of an Amphibian Chytrid Fungus,” \$500.
- Edwin Cadena, Department of Marine, Earth and Atmospheric Sciences, North Carolina State University. “A New Fossil Turtle from the Early Cretaceous (Barremian-Aptian) of Colombia (South America); Revealing the Early Stages of Marine Turtles Evolution,” \$1,000.
- Chip Cochran, Department of Earth and Biological Sciences, Loma Linda University. “Investigating Venom Variation in *Crotalus mitchellii pyrrhus* across Its Range by Proteomic and Transcriptome Analysis,” \$1,000.
- Forest Preserve District of DuPage County (Dan Thompson, Principal Investigator). “Blanding’s Turtle Recovery Program, DuPage County, Illinois,” \$1,000.
- Joseph Frumkin, University of Illinois at Urbana-Champaign (undergraduate). “The Role of Color Morph on Territoriality in the Red-backed Salamander, *Plethodon cinereus*,” \$1,000.
- Kory H. Heiken, Biological Sciences Department, California Polytechnic State University. “The Physiological Effects of Long-distance Translocation on Southern Pacific Rattlesnakes (*Crotalus oreganus helleri*),” \$500.
- Dustin Owen, Ball State University (undergraduate). “Physiological Impacts of Silviculture Treatments and Roads on Copperheads (*Agkistrodon contortrix*),” \$500.
- Thomas Andrew Radzio, Department of Biology, Drexel University. “Effects of Season and Thermal Environment on Behavioral Thermoregulation and Its Relative Costs in Juvenile Gopher Tortoises,” \$1,000.
- Rebecca Tarvin, Ecology, Evolution and Behavior, The University of Texas at Austin. “Does Alkaloid Insensitivity Facilitate Aposematism and Diet Specialization in Poison Frogs?” \$500.
- Marisa Tellez, Department of Ecology and Evolutionary Biology, University of California, Los Angeles. “Environmental and Anthropogenic Impact on Parasitism between *Alligator mississippiensis* in Florida and Louisiana,” \$500.
- Kyle Weichert, Biological Sciences Department, California Polytechnic State University. “Does Host Lizard Sex Affect Their Ability to Kill the Lyme Disease Causative Agent *Borrelia burgdorferi*?” \$500.
- Andrew William Whitworth, College of Medical, Veterinary & Life Sciences, University of Glasgow. “The Conservation Value of Regenerating Tropical Forests for Amphibians and Reptiles and the Threats Involved, Manu Biosphere Reserve, Southern Peru,” \$500.

ReptileFest 2012

April 14–15

It's creeping up on you

UPCOMING MEETINGS

The next meeting of the Chicago Herpetological Society will be held at 7:30 P.M., Wednesday, February 29, at the Peggy Notebaert Nature Museum, Cannon Drive and Fullerton Parkway, in Chicago. The speaker will be **Mike Pingleton** of Champaign, Illinois. Mike, a field herper extraordinaire, will speak on “Herping in Mexico.”

Speaking at the March 28 meeting will be **Marisa Tellez**, a Ph.D. candidate in biology at UCLA. Marisa’s topic will be “The Good, the Bad, and the Ugly — Investigating the Interaction between the American Alligator and Its Parasites.” Marisa’s research is the first in-depth study to investigate the relationships between a crocodilian and its parasites.

The regular monthly meetings of the Chicago Herpetological Society take place at Chicago’s newest museum—the **Peggy Notebaert Nature Museum**. This beautiful building is at Fullerton Parkway and Cannon Drive, directly across Fullerton from the Lincoln Park Zoo. Meetings are held the last Wednesday of each month, from 7:30 P.M. through 9:30 P.M. Parking is free on Cannon Drive. A plethora of CTA buses stop nearby.

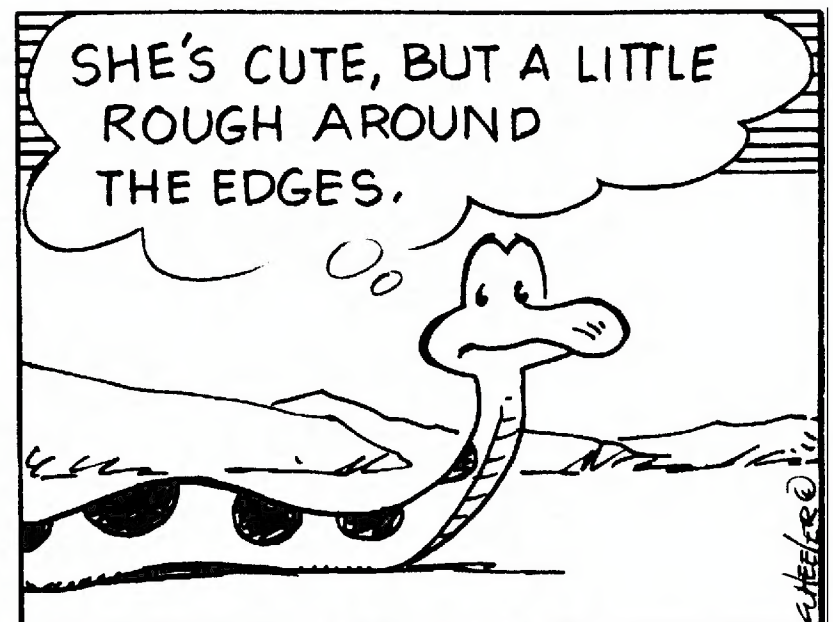
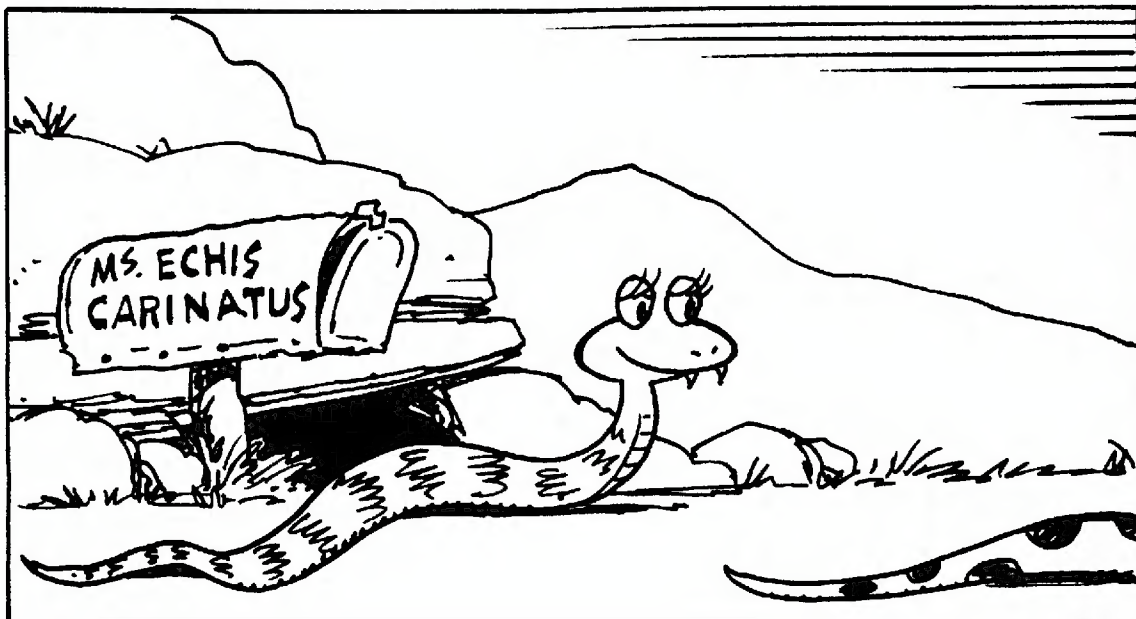
Board of Directors Meeting

Are you interested in how the decisions are made that determine how the Chicago Herpetological Society runs? And would you like to have input into those decisions? If so, mark your calendar for the next board meeting, to be held at 7:30 P.M., March 23, at the Wildlife Discovery Center at Elawa Farms, 1401 Middlefork Drive, Lake Forest, Illinois.

The Chicago Turtle Club

The monthly meetings of the Chicago Turtle Club are informal; questions, children and animals are welcome. Meetings normally take place at the North Park Village Nature Center, 5801 N. Pulaski, in Chicago. Parking is free. For more info visit the group’s Facebook page.

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